**The Geometry of Lines** Name:

Rodriguez/Geo

Let’s talk about lines. ☺

**Part 1: Parallelism**

1. What does it mean for lines to be parallel? Describe and draw below:

2. How would you decide whether lines are parallel?

Euclid, an Ancient Greek geometer who developed the math you’ll be studying in this course*,* defined parallel lines as lines that never meet, even when extended indefinitely (on and on and on…).

It was hard for the Greeks, though, to determine if lines were parallel — after all, how could you show *for sure* that lines never met? What if you thought that lines were parallel, but actually they met at a point 1,000 miles away? This would happen if lines were very close to being parallel, but not quite.

Here’s an example of this issue:

These lines may look parallel, but they actually aren’t—one line is slightly “off.”

It’s not safe to assume from any picture that lines are indeed parallel.



3. Stop for a sec: how can you make sense of this? How can we tell FOR SURE that lines are parallel?

In the 1600s, the French mathematician and philosopher Rene Descartes changed the way people thought about — and did — geometry. The story goes that he was lying in bed one day, staring at the ceiling, and realized that he could describe the position of a bug on his ceiling by counting the number of ceiling cracks up and the number of ceiling cracks over.

He developed the coordinate plane that we use today—which helps not only with making graphs, but tracking position and much more. Descartes essentially found a way to bring algebra and geometry together.

(However: the Ancient Greeks developed the ideas of latitude and longitude and using lines to determine positions of cities, and that’s a precursor of the coordinate system.)

But I digress!

4. Let’s be like Descartes and put lines on a grid.

How could we use this grid to figure out whether the lines are parallel?



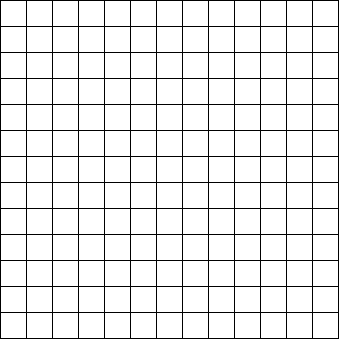
Final side note:

Descartes’s idea allowed someone to take a geometric shape — like a line — and describe its position *exactly* by putting a grid on top of it — a coordinate system. Since these coordinates had numbers attached, all of the sudden people were able to apply much of what they already knew about algebra to geometry. Descartes had allowed people to use multiple points of view when considering geometry problems, switching freely back and forth between an algebraic perspective and a geometric perspective. And, when you thought about #4, so did you!

**Part 2: More Parallelism**

1. Say you live in a city where the streets are laid out in a square grid pattern. You start at your house and walk two blocks north, then three blocks east.

a) Draw the situation on the grid.

[](http://puzzles.about.com/library/grids/qblank13.htm)

b) Find the slope of the line segment that connects your house and your end point.

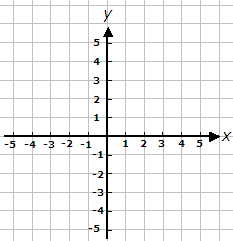
c) Your friend lives two blocks south of you. She starts at her house, then follows the same pattern as you — two blocks north and three blocks east.

i. Draw a picture of your friend’s path (on this

same grid).

ii. Are your path and you friend’s paths “parallel” (even though neither of you went in a straight line)? Explain this.

2. a) Draw the points (1,2) and (2,5). Draw the line through them — this is line *m* .

[](http://www.helpingwithmath.com/printables/worksheets/geometry/geo0701coords12.htm)

b) Line *n* contains the point (3,1) and is parallel to line *m.* Draw line *n.* (On the same grid.)

c) The point (5, ??) is on line *n*. Find “??”.

d) What are the slopes of lines *m* and *n*?

3. Based on your thinking in the previous problems, say what must be true for two lines to be parallel.

**BIG IDEA: Parallel lines…** (don’t write here until we discuss it together)

**Part 3: Perpendicular Lines**

What about lines that are perpendicular to each other — that is, lines that cross at a 90 degree angle?

1. First, think/discuss:

* Can two lines, each with positive slope, be perpendicular?
* Can two lines, each with a negative slope, be perpendicular?

2. Using graph paper, draw a line segment (not horizontal or vertical), and use a measuring tool (a protractor? the corner of a piece of paper?) to draw another line segment perpendicular to the first. Then calculate the slopes of the two segments you drew. Then, look for patterns.

(What do you suppose would be more helpful in looking for patterns — writing the slopes in fraction or decimal form?)

Observations/patterns:

3. After you finish #2, determine a relationship between the slopes of perpendicular lines. (It may help to discuss this with other people AFTER you think of something by yourself.

4. Test out your ideas from #3:

a) Draw a line with a slope of 3. What should be the slope of a line perpendicular to it?

b) Draw a line with a slope of -2/5. What should be the slope of a line perpendicular to it?

**BIG IDEA: Perpendicular lines…** (don’t write here until we discuss it together)

**Part 4: Some Algebra**

Remember equations of lines…like these?

y = -2x – 6 y = 4x + 2 y = -5x – 10 y = (5/6)x + 112 etc…

1. What’s the slope of each line above?

2. Write the equations of two lines that are parallel to each other (make these up yourself):

3. Write the equations of two lines that are perpendicular to each other (make these up yourself):